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1. An apparatus for three dimensional inspection of an electronic part, wherein the apparatus is calibrated using a precision pattern mask with dot patterns deposited on a calibration transparent reticle, the apparatus for three dimensional inspection of an electronic part comprising:
- (a) a camera and an illuminator for imaging the electronic part, the camera being positioned to obtain a first view of the electronic part;
  - (b) a means for light reflection positioned to reflect a different view of the electronic part into the camera, wherein the camera provides an image of the electronic part having differing views; and
  - (c) a means for image processing the image of the electronic part that applies calculations on the differing views of the image to calculate a three dimensional position of at least one portion of the electronic part.
2. The apparatus of claim 1 wherein the illuminator further comprises a ring light.
3. The apparatus of claim 1 wherein the means for light reflection further comprises a mirror.

- 1 4. The apparatus of claim 1 wherein the means for light  
2 reflection further comprises a prism.
- 1 5. The apparatus of claim 1 wherein the means for light  
2 reflection further comprises a curved mirror.
- 1 6. The apparatus of claim 1 wherein the electronic part  
2 further comprises a ball grid array.
- 1 7. The apparatus of claim 6 wherein the electronic part  
2 further comprises balls on a wafer.
- 1 8. The apparatus of claim 6 wherein the electronic part  
2 further comprises balls on a die.
- 1 9. The apparatus of claim 1 wherein the means for imaging  
2 provides the image to a frame grabber board.
- 1 10. The apparatus of claim 9 wherein the frame grabber  
2 board provides an image data output to a processor to  
3 perform a three dimensional inspection of a part.
- 1 11. The apparatus of claim 1 further comprising a nonlinear  
2 optical element to magnify the image in one dimension.
- 1 12. The apparatus of claim 1 wherein a maximum depth of

2 focus of a side perspective view allows for a fixed  
3 focus system to inspect larger electronic parts, with  
4 one perspective view imaging one portion of the  
5 electronic part and a second perspective view imaging a  
6 second portion of the electronic part.

1 13. The apparatus of claim 1 wherein a maximum depth of  
2 focus of a side perspective view includes an area of  
3 the electronic part including a center row of balls.

1 14. The apparatus of claim 13 wherein all of the balls on  
2 the electronic part are in focus resulting in two  
3 perspective views for each ball.

1 15. The apparatus of claim 1 further comprising a means for  
2 inspecting gullwing and J lead devices.

1 16. A method for three dimensional inspection of a lead on  
2 a part, the method comprising the steps of:  
3 (a) using a camera to receive an image of the lead;  
4 (b) transmitting the image of the lead to a frame  
5 grabber;  
6 (c) providing fixed optical elements to obtain a side  
7 perspective view of the lead;  
8 (d) transmitting the side perspective view of the lead  
9 to the frame grabber;

- 10 (e) operating a processor to send a command to the  
11 frame grabber to acquire images of pixel values  
12 from the camera; and  
13 (f) processing the pixel values with the processor to  
14 calculate a three dimensional position of the  
15 lead.

1 17. The method of claim 16 wherein the step of processing  
2 the pixel values further comprises determining state  
3 values from the part itself.

1 18. The method of claim 16 wherein the lead is a curved  
2 surface lead.

1 19. The method of claim 16 wherein the lead is a ball.

1 20. The method of claim 16 wherein the part is a ball grid  
2 array.

1 21. The method of claim 16 wherein the processor processes  
2 the pixel values to find a rotation, an X placement  
3 value and a Y placement value of the part relative to  
4 world X and Y coordinates by finding points on four  
5 sides of the part.

1 22. The method of claim 21 further comprising the steps of:

- 2 (a) using a part definition file that contains  
3 measurement values for an ideal part;
- 4 (b) calculating an expected position for each lead of  
5 the part for a bottom view using the measurement  
6 values from the part definition file and the X  
7 placement value and Y placement value.
- 1 23. The method of claim 16 further comprising the step of  
2 using a search procedure on the image to locate the  
3 lead.
- 1 24. The method of claim 16 further comprising the step  
2 using a subpixel edge detection method to locate a  
3 reference point on each lead.
- 1 25. The method of claim 16 further comprising the step of  
2 determining a lead center location and a lead diameter  
3 in pixels and storing the lead center location and lead  
4 diameter in memory.
- 1 26. The method of claim 25 further comprising the step of  
2 calculating an expected position of a center of each  
3 lead in the side perspective view in the image using a  
4 known position of the side perspective view from  
5 calibration.

1 27. The method of claim 25 further comprising the step of  
2 converting the pixel values into world locations by  
3 using pixel values and parameters determined during  
4 calibration wherein the world locations represent  
5 physical locations of the lead with respect to world  
6 coordinates defined during calibration.

1 28. The method of claim 27 wherein a Z height of each lead  
2 is calculated in world coordinates in pixel values by  
3 combining a location of a center of a lead from a  
4 bottom view with a reference point of the same lead  
5 from a side perspective view.

1 29. The method of claim 28 further comprising the step of  
2 converting the world coordinates to part values using a  
3 rotation, X placement value and Y placement value to  
4 define part coordinates for an ideal part where the  
5 part values represent physical dimensions of the lead  
6 including lead diameter, lead center location in X part  
7 and Y part coordinates and lead height in Z world  
8 coordinates.

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1 30. The method of claim 29 further comprising the step of  
2 comparing ideal values defined in a part file to  
3 calculate deviation values that represent a deviation  
4 of the center of the lead from its ideal location.

1 31. The method of claim 30 wherein the deviation values may  
2 include lead diameter in several orientations with  
3 respect to an X placement value and a Y placement  
4 value, lead center in the X direction, Y direction and  
5 radial direction, lead pitch in the X direction and Y  
6 direction and missing and deformed leads, further  
7 comprising the step of calculating the Z dimension of  
8 the lead with respect to a seating plane based on Z  
9 world data.

1 32. The method of claim 31 further comprising the step of  
2 comparing the deviation values to predetermined  
3 tolerance values with respect to an ideal part as  
4 defined in a part definition file to provide a lead  
5 inspection result.

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